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ABSTRACT

Statistical evaluation indicated the effectiveness of 10 software packages used in a 3-year project to improve the reading and language skills of Limited English Proficient (LEP) Native American students. The project was implemented in four Rapid City (South Dakota) schools in which 79% of the Lakota (Sioux) Indian students (grades 3-6) were found to be LEP and focused upon the application of microcomputer software in realizing its goals. Stepwise regression was used to ascertain the relationship between Comprehensive Tests of Basic Skills scores and the number of times a student used a particular software package. Analysis of second-year project data showed that Microzine, Learning Company, and Educational Activities software provided the best gain in vocabulary; Microzine, Data Command, and Universal Systems of Education PAL software contributed most to gains in comprehension; and Microzine was the best predictor of composite reading improvement. Analysis of third-year project data showed Borg-Warner, PAL, and Developmental Learning Materials (DLM) software produced best vocabulary gains; Microzine, Borg Warner, and DLM produced best comprehension gains; and Borg Warner was associated with the best gains in composite reading achievement. Specifications of the computer software packages used are provided. (NEC)

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THE RELATIONSHIP BETWEEN INDIVIDUAL SOFTWARE PACKAGES AND READING IMPROVEMENT IN AN EXPERIMENTAL CAI PROGRAM

A Paper Presented At The
Northern Rocky Mountain Educational
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This paper was developed from the final evaluation of the Years II and III (1983-84 and 1984-85) phases of the program "Computer Assisted Instruction for Bilingual/Bicultural Students" funded by the Office of Bilingual Education and Minority Language Affairs (OBEMLA), an office of the U.S. Department of Education. The grant is administered through the Office of Bilingual/Bicultural Education, an agency of the Rapid City Area School District 51-4.

General Overview

The ultimate goal of the three-year project was to improve the reading and language skills of an identified group of Limited English Proficient (LEP) Native American students.

Lakota (Sioux Indian) children constitute 10% of the Rapid City school population. The project was implemented in four elementary schools which contained the highest numbers of Lakota children. Indian children who were identified as LEP (< 50 percentile) were chosen as participants.

The unique characteristic of the project was the focus upon the application of microcomputers and microcomputer software in realizing the overall project

goals.

Since the use of such a technologically innovative approach was so new, very little research had been evidenced that provided process models and/or assistance in this area. Hence, the project was plowing new ground in the areas of curriculum development and pedagogy and had implications for baseline research, as well as the fulfillment of the immediate educational goal. The actual purpose of the project was:

1. To develop and incorporate into purchased educational programs instructionally appropriate Lakota cultural and English language arts and reading material.

2. To develop pedagogically appropriate programmed materials for use with microcomputers.

3. To train instructional staff in the methods of CAI technology and relevant bilingual education methodology.

As stated above, the project was focused upon the Lakota children in four target schools. In these schools, 79% of the Lakota students (grades 3-6) were found to have Limited English Proficiency. These students were chosen using a combination of methods including: (a) standardized test scores, (b) assessment scale scores, (c) a review of demographic information

which included family income, and (d) teacher/principal input.

Objectives

The grant proposal delineated the objectives according to those which were to be achieved upon the completion of the three-year project and those which were to be achieved upon the completion of the first year of the project (Year I). These objectives were modified in Years II and III to include the following.

1.0 As a result of participation in this program, significant growth ($P \leq .05$) will be evidenced in 75% of the reading subscale groupings as measured by the Comprehensive Test of Basic Skills (CTBS).

2.0 After examining the CAI records in regard to actual student participation with individual software packages, the three best packages will be identified using a regression approach.

3.0 By the end of the third project year 95% of the bilingual education staff will have participated in all training and technical assistance activities.

4.0 By the end of the third project year 95% of the bilingual education instructional staff will have received training in the operation of the desk top

microcomputers and methods for developing new CAI programs.

It should be noted that this paper was limited to an examination of Objective 2.0 above. Therefore, the major focus in this papere was placed upon statistical evidence of the effectiveness of software packages rather than instructional processes.

Methodology

Stepwise Regression

Stepwise Regression is a statistical approach that is based upon the principle of correlation or covariability between and among variables. In simple terms this means that some variables are related (co-relate - correlation) in that they vary (co-vary - covariance) together (in the same pattern). In the present project the variability or correlation we want to ascertain is the relationship between the gain in CTBS scores (dependent or criterion variables) and the number of times a student used an individual CAI package (independent or predictor variables) while working in the lab. If these variables are related, those students who spend more time using a "good" software package would have registered higher gain

scores and those students who had used it less would have achieved smaller NCE gains. In other words, the two variables are "co-related" (correlation) because they "co-vary". This relationship is expressed as a correlation coefficient. Correlation coefficients range in value from a -1.0 (actually -.99) to a value of 1.0 (actually .99). Simple correlations are generally designated in research reports as r. Sometimes groups of variables are compared simultaneously. In this case we say that the correlation coefficient is a multiple correlation. This statistic has the same range (-1.0 to 1.0) but is symbolized with a capital R.

In stepwise regression, a group of independent or predictor variables (in the present case sessions spent with individual CAI packages) were compared simultaneously to one dependent or criterion variable (in the present analysis, NCE gain on one of the reading subtests) to see which predictor variables have the greatest relationship with NCE gain. This is realized in a series of steps. In the first step, the single best predictor is established, the multiple correlation (R) is determined, and the probability of the relationship (P) is noted. In the second step, the next best predictor is added and the R value is increased.

This process is continued until all of the predictor variables have been analyzed.

The application of this procedure is to determine the best combination of predictor variables. This is realized by examining the growth of the multiple correlation coefficient (R). At some point during the analysis the R value will stabilize and hence stop growing. A rule of thumb for evaluation is to use the predictor variables included in the previous step as the best possible combination of predictors. In this manner we can also determine the best combination of software experiences for next year's students.

CAI Evaluation Year II

As noted in Objective 2.0, actual effectiveness of the different CAI processes were to be compared with any growth evidenced in test scores. The objective here was to pinpoint those elements of treatment processes which had the greatest effect upon growth in three major CTBS reading scores which included Vocabulary, Comprehension and Composite Reading.

A total of eleven (11) independent or predictor variables were entered into the regression in an attempt to determine which dimension of the treatment

processes had the greatest effect upon gain in the dependent (criterion) variables or NCE growth in the three major CTBS reading scores. The predictor variables included the ten CAI packages as well as the total number of days in the lab. The actual number used to represent the magnitude of exposure to any one of the CAI packages was the actual number of days each student spent working with the software.

The CAI predictor variables were described as follows:

1. BLS (Ombudsman Services)
2. Borg-Warner (Borg-Warner Publications)
3. Data Command (Imperial International)
4. DLM (Developmental Learning Materials)
5. Educational Activities (Educational Activities Publications)
6. Learning Company (Learning Company Inc.)
7. Microzine (Scholastic Incorporated)
8. Other (Various Publishers)
9. PAL (Universal Systems of Education)
10. Readers Digest (Readers Digest)

Software and Gain in Vocabulary (CTBS)

The stepwise regression procedure for determining

those software packages which contributed the most (were most related to) to gain in Vocabulary (CTBS) was summarized in Table 1. As can be noted, the best predictor was the Microzine materials (R = .23, P = .017) followed by Readers Digest, Learning Company and Educational Activities (R = .32, P = .026). It should be noted that beginning at Step 5, the multiple correlation (R) begins to stabilize at .34/.35 and hence the activity conducted with the rest of these packages added little or nothing to the student gain scores.

One complication was revealed in this analysis. Examination of individual correlation coefficients (r) revealed that the Readers Digest activity was negatively correlated. Hence more activity with this software actually diminished student gain. We can therefore conclude that the three best predictors (and hence the three most productive software experiences) for gain in Vocabulary were Microzine, Learning Company and Educational Activities.

Software and Gain in Comprehension (CTBS)

Table 2 was used to present the stepwise regression procedure for determining gain in Comprehension scores. As can be noted, the growth in R was stabilized at Step

Table 1

Stepwise Forward Procedure with Vocabulary as Criterion

N=108

Step	Predictor Variable	R	F	P
1	Microzine	.23	5.84	.017
2	Readers Digest*	.27	3.89	.024
3	Learning Company	.29	3.10	.029
4	Educational Activities	.32	2.88	.026
5	Data Command	.34	2.53	.033
6	Other	.34	2.15	.053
7	Borg-Warner	.34	1.87	.083
8	DLM	.35	1.64	.123
9	Days on Task	.35	1.45	.180
10	BLS	.35	1.29	.247
11	PAL	.35	1.29	.247

*Negative Correlation

Table 2

Stepwise Forward Procedure with Comprehension as Criterion

N=108

Step	Predictor Variable	R	F	P
1	Microzine	.23	5.93	.016
2	Readers Digest*	.28	4.52	.013
3	Data Command	.30	3.29	.024
4	PAL	.35	3.56	.009
5	Other	.36	3.02	.014
6	BLS	.38	2.75	.016
7	Days on Task	.38	2.43	.025
8	DLM	.39	2.23	.031
9	Educational Activities	.40	2.06	.040
10	Learning Company	.40	1.85	.062
11	Borg-Warner	.40	1.67	.093

*Negative Correlation

6, with some minimal growth continuing on to Step 8. It was also noted that the Readers Digest materials were again negatively correlated.

We can therefore conclude that Microzine, Data Command and PAL contributed most to the gain process, while BLS and Other should probably be retained and examined for further study.

Software and Gain in Composite Reading (CTBS)

The stepwise regression procedure for determining those software packages which contributed most to gain in Composite Reading scores were summarized in Table 3. As can be noted, the best predictor was Microzine (R = .23) followed by Educational Activities, Data Command and BLS. The relationship with Readers Digest was negative. It can therefore be concluded that the best approach would be to emphasize these three or four CAI packages in Year III of the project.

CAI Evaluation Year III

A total of ten 10 independent or predictor variables were entered into the regression in an attempt to determine which dimension of the treatment processes had the greatest effect upon gain in the dependent (criterion) variables or NCE growth in the

Table 3

Stepwise Forward Procedure with Composite Reading as Criterion

N=108

Step	Predictor Variable	R	F	P
1	Microzine	.23	5.59	.019
2	Educational Activities	.30	4.96	.008
3	Readers Digest*	.32	3.77	.013
4	Data Command	.36	3.82	.006
5	BLS	.37	3.49	.006
6	PAL	.39	3.01	.009
7	DLM	.40	2.62	.016
8	Days on Task	.40	2.34	.024
9	Learning Company	.40	2.08	.039
10	Borg-Warner	.40	1.85	.062
11	Other	.40	1.67	.092

*Negative Correlation

three major CTBS reading scores. The predictor variables included the nine (9) CAI packages as well as the total number of days in the lab. The actual number used to represent the magnitude of exposure to any one of the CAI packages was the actual number of days/ sessions each student spent working with the software.

The CAI predictor variables were described as follows:

1. Borg-Warner (Borg-Warner Publications)
2. Data Command (Imperial International)
3. DLM (Developmental Learning Materials)
4. Hartley (Hartley Publication)
5. Microzine (Scholastic Incorporated)
6. Other (Various Publishers)
7. PAL (Universal Systems of Education)
8. Spinnaker (Spinnaker Publications)
9. Sunburst (Sunburst Publications)

Software and Gain in Vocabulary (CTBS)

The stepwise regression procedure for determining those software packages which contributed the most (were not related to) to gain in Vocabulary (CTBS) was summarized in Table 4. As can be noted, the best predictor was the Borg Warner materials (R = .15),

Table 4

Stepwise Forward Procedure with Gain in Vocabulary as Criterion

N=114

Step	Predictor Variable	R	F	P
1	Borg-Warner	.15	2.39	.125
2	PAL	.19	2.11	.126
3	Hartley*	.26	2.69	.049
4	DLM	.31	2.87	.026
5	Sunburst	.32	2.41	.041
6	Other	.34	2.28	.041
7	Spinnaker	.35	2.03	.058
8	Days on Task	.35	1.86	.074
9	Data Command	.37	1.80	.076
10	Microzine	.37	1.62	.112

*Negative Correlation

P = .125) followed by PAL, Hartley and DLM (R = .31, P = .026). It should be noted that beginning at Step 5/6 the multiple correlation (R) begins to stabilize at .32/.34 and hence the activity conducted with the rest of these packages added little or nothing to the student gain scores.

One complication was revealed in this analysis. Examination of individual correlation coefficients (r) revealed that the Hartley activity was negatively correlated. Hence more activity with this software actually diminished student gain. We can therefore conclude that the three best predictors (and hence the three most productive software experiences) for gain in Vocabulary were Borg Warner, PAL and DLM.

Software and Gain in Comprehension (CTBS)

Table 5 was used to present the stepwise regression procedure for determining gain in Comprehension scores. As can be noted, the growth in R was stabilized at Steps 4/5 with minimal growth continuing in the ensuing steps. It was also noted that the Hartley materials were again negatively correlated.

We can therefore conclude that Microzine, Borg Warner, and DLM contributed most to the gain process.

Table 5

Stepwise Forward Procedure with Gain in Comprehension as Criterion

N=114

Step	Predictor Variable	R	F	P
1	Microzine	.16	2.86	.093
2	Hartley*	.24	3.26	.042
3	Borg-Warner	.28	3.02	.034
4	DLM	.32	3.03	.021
5	Spinnaker	.32	2.43	.039
6	Days on Task	.32	2.04	.067
7	Sunburst	.33	1.77	.099
8	PAL	.33	1.58	.139
9	Data Command	.33	1.41	.195
10	Other	.33	1.26	.258

*Negative Correlation

Software and Gain in Composite Reading (CTBS)

The stepwise regression procedure for determining those software packages which contributed most to gain in Composite Reading scores were summarized in Table 6. As can be noted, the best predictor was Borg Warner (R =.18) followed by Hartley, DLM and Sunburst. The relationship with Hartley was negative. It can therefore be concluded that the best approach would be to emphasize these three or four CAI packages in future applications.

Table 6

Stepwise Forward Procedure with Gain in Composite Reading as Criterion

N=114

Step	Predictor Variable	R	F	P
1	Borg-Warner	.18	3.72	.056
2	Hartley*	.30	5.38	.006
3	DLM	.41	7.40	.000
4	Sunburst	.42	5.79	.000
5	Other	.43	4.88	.000
6	Microzine	.44	4.09	.001
7	PAL	.44	3.49	.002
8	Days on Task	.44	3.11	.004
9	Data Command	.44	2.73	.007
10	Spinnaker	.44	2.44	.012

*Negative Correlation